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appeared at ſeveral different points, with very little difference of time. At firſt, they were nearly circular ; but they rapidly extended themſelves along the limb of the ſun, till uniting, they completed the annulus. At the ſecond contact, ſeveral breaches in the annulus almoſt inſtantaneouſly ſucceeded the firſt, at different diſtances from each other ; and the oblong drops included between them, contracted and vaniſhed.

The ſky was perfectly clear, during the whole time of the eclipſe ; and our obſervation was not interrupted by the intervention of a ſingle cloud.

The fear of loſing an obſervation of one of the contacts prevented my taking any meaſures with a micrometer ; as the only one in my poſſeſſion is fitted to the teleſcope, with which I obſerved the contacts ; and ſome time would be requiſite to adjuſt it to the micrometer, and afterwards for uſe without it.

* * *

## V. *Obſervations of the Tranſit of Mercury over the Sun's Diſc, November* 5th, 1789, *by the Rev.* JOSEPH WILLARD, D. D. *Preſident of the Univerſity, and Vice Preſident of the American Academy of Arts and Sciences.*

THE circumſtances attending the tranſit of Mercury, which happened November 12th, 1782, were more favourable in North America than in Europe. The altitude of the Sun was much greater at the beginning of the tranſit, and the whole was viſible to us ; whereas the Sun ſat in

Europe, before the two laſt contacts happened. But Mercury's latitude was then ſo great, that the times of the contacts could by no means be determined, with that preciſion as when the latitude is ſmall. For this reaſon, the tranſit of November 5th, this year, became more peculiarly intereſting. And it was of more importance that it ſhould be obſerved in America, as the whole was viſible to us, which it was not to the Europeans.

Having determined to make as accurate obſervations upon this tranſit, as ſhould be in my power, I began to take equal altitudes of the Sun, to aſcertain the going of my clock, as early as the twentieth day of October: and, by obſervations made on that day, and the 22d and 23d, I found, that it did not deviate from keeping equal time, more than half a ſecond in twenty four hours. After the 23d, the weather became peculiarly unfavourable for obſervations of the Sun, on account of clouds and rain; ſo that I could not obtain a complete ſet of equal altitudes, till the 2d day of November; when I found that the Sun paſſed the meridian by my clock, making the equation for the change of declination, during the half interval between the forenoon and afternoon obſervations, at $11^h\ 59'\ 33''\ 17'''$. The 3d and 4th days of the month were cloudy; but, on the morning of the 5th, the day of the tranſit, the atmoſphere was very clear; not a cloud was to be ſeen; and there was nothing unfavourable to obſervations of this phenomenon, except the wind, which at times was pretty high. This however, did not prevent the contacts' being determined with great exactneſs.

For obſerving the contacts, I was furniſhed with an excellent achromatick teleſcope of $3\frac{1}{2}$ feet long; the largeſt magnifying power of which is 90, and is that which I made uſe of upon this occaſion. For meaſuring diſtances, I had Dollond's micrometer, fitted to a reflecting teleſcope of a foot long.

About a quarter of an hour before the time when the firſt contact was expected by calculation, I ſat down to my teleſcope: and having previouſly determined the part of the Sun's limb, where the firſt impreſſion would be made, I endeavoured to keep that point, as near as I could judge, in the centre of the field of view: and ſuch was its ſituation at the time of the firſt external contact, which happened at $8^h\ 24'\ 4''$, A. M. apparent time. The atmoſphere appeared very clear, and there was no undulation of the Sun's limb, but it was in a ſmall degree ſerrated; and nothing but that appearance could give an uncertainty to this obſervation. Poſſibly there might be an errour on this account, of two or three ſeconds. But, the indents upon the limb were by no means, ſo large as in the tranſit of November 12th, 1782, at the time of the firſt contact.

The apparent time of the firſt internal contact was $8^h\ 25'\ 52''$. No uncertainty ſeemed to attend this obſervation; and as ſoon as Mercury was wholly within the Sun, his diſc appeared perfectly circular.

I meaſured the diſtance of Mercury from the Sun's limb a number of times, whilſt he was paſſing over the diſc; but the wind was ſo high and troubleſome, when I was uſing that ſhort and unſteady teleſcope, to which the micrometer was fixed, that I was not ſo far ſatisfied with them at the time, as to ſuppoſe they could be ſafely uſed to determine the leaſt diſtance of centres : but was perſuaded, that if the obſervations of the two laſt contacts ſhould be as favourable as thoſe of the two firſt, the leaſt diſtance of centres, and the latitude of Mercury, might with more accuracy, be deduced from the contacts, than from any of the micrometer meaſures. I did not attempt, on the ſame account, to meaſure Mercury's ſemidiameter by the micrometer, but left it to be determined from the contacts. As the Sun's diameter was a large angle, and could more eaſily be taken than ſmall ones, I applied the micrometer ſeveral times, to meaſure it, when the wind was leaſt troubleſome ; and found it, parallel with the horizon, to be 32′ 24″ 33.

The atmoſphere was perfectly clear at the time of the two laſt contacts ; and I found the internal one happened at 1<sup>h</sup> 15′ 44″. P. M. and the external one at 1<sup>h</sup> 17′ 36″ P. M. both apparent time.

I took correſponding altitudes of the Sun on the day of the tranſit ; and found, that when it paſſed the meridian, it was, by my clock, uſing the proper equation for change of declination, 11<sup>h</sup> 59′ 36″ 22‴. From the 2d of November therefore, to the 5th, the clock had gained upon apparent time 3″ 5‴. If it had kept mean time exactly, it would have gained 3″ 54‴. Hence it appears, that it deviated but about $\frac{1}{4}$ of a ſecond in twenty four hours, from keeping mean time.

Having had ſo good obſervations of this phenomenon, I thought it my duty to communicate them to the Academy.

And I ſhall conclude the paper by making thoſe deductions from them, which I hope, may in ſome meaſure, ſubſerve the intereſts of Aſtronomy.

The elements for the calculations are from M. Mayer's Tables of the Sun, publiſhed in the year 1770, and M. de la Lande's Tables of Mercury, in the firſt volume of the ſecond edition of his Aſtronomy, publiſhed in the the year 1771; reckoning the difference of meridians between Cambridge, and the Royal Obſervatory at Greenwich, $4^h\ 44'\ 31''$; and between Cambridge, and the Royal Obſervatory at Paris, $4^h\ 53'\ 47''$.

By theſe tables we find ☿'s diſtance from the Sun, reduced to the ecliptick, at the time of the conjunction, Log. 4. 498326, in numbers = 31501; the Sun's diſtance from the earth, Log. 4. 995777, in numbers = 99032; Mercury's diſtance from the earth therefore, in numbers, was 67531 = Log. 4. 829503. By the beſt calculations, from the obſervations of the tranſit of Venus, made in the year 1769, the Sun's horizontal parallax, on the day of the tranſit of Mercury, muſt have been $8''.85$. Having theſe requiſites, we may find Mercury's horizontal parallax thus :—— ☿'s diſtance from the earth : ☉'s diſtance from it :: ☉'s horizontal parallax : ☿'s horizontal parallax; which is found = $12''.978$: conſequently, ☿'s horizontal parallax from ☉ = $4''.128$.

The Sun's horary motion, during the tranſit, was $2'\ 30''.7$: Mercury's heliocentrick horary motion in longitude in the ecliptick, at the time of the firſt external contact, was $14'\ 59''$; and at the time of the ſecond, $15'\ 3''$: conſequently, his motion from the Sun, $12'\ 28''.3$ and $12'\ 32''.3$;

from which we may find Mercury's horary motion upon the Sun's diſc, with reſpect to the eclíptick, at the beginning of the tranſit, 5′ 49″. 059 ; and at the end, 5′ 50″. 955. This was the compound motion of the Sun and Mercury ; Mercury's motion being retrograde. If therefore, we ſubſtract the Sun's horary motion, we ſhall have Mercury's geocentrick horary motion in longitude, at the beginning of the tranſit, 3′ 18″. 359 ; and at the end, 3′ 20″. 255.

Mercury's heliocentrick motion in longitude, from $8^{h}$ 24′ 4″, the time of the firſt external contact, till $10^{h}$ 39′ 31″, the time of the ecliptick conjunction, by the tables, was 33′ 50″. 1, making 28′ 9″. 9 from the Sun, and 13′ 8″. 29 for his motion upon the Sun's diſc, which makes his geocentrick motion in longitude 7′ 28″. 09. The ſimilar motions, from $10^{h}$ 39′ 31″ to $1^{h}$ 17′ 36″, the time of the ſecond external contact, were 39′ 35″. 2, 32′ 58″. 2, 15′ 22″. 77 and 8′ 45″. 77. Mercury's horary motion in latitude, at the beginning of the tranſit, was 51″. 404 ; and at the end, 51″. 685 ; and, from $8^{h}$ 24′ 4″ to $10^{h}$ 39′ 31″, 1′ 56″. 011 ; and from $10^{h}$ 39′ 31″, to $1^{h}$ 17′ 36″, 2′ 16″. 115, decreaſing.

The longitude of the Sun therefore, and Mercury's geocentrick longitude, by the tables, at $10^{h}$ 39′ 31″, being $7^{s}$ 13° 40′ 56″. 5 ; and the latitude of Mercury, 7′ 27″. 95, we ſhall find,

At the time of the firſt external contact, viz. $8^{h}$ 24′ 4″ A. M.

| | |
|---|---|
| ☉'s longitude. | $7^{s}$ 13° 35′ 16″. 3 |
| ☿'s geocentrick longitude. | 7 13 48 24. 59 |
| ☿'s geocentrick latitude. | 9 23.961 |
| ☉'s right aſcenſion. | 221 7 34 |

Right

| | |
|---|---|
| Right aſcenſion of the mid heaven. | 167° 8′ 34″ |
| Which being ſubſtracted from 270°, gives ∠ at the pole. | 102 51 26 |
| ☉'s ſemidiameter, by obſervation. | 16 12. 125 |
| The obliquity of the ecliptick. | 23 28 0 |
| Latitude of Cambridge, 42° 23′ 28″ N. reduced to centr. | 42 8 37 |

From theſe elements, we find the longitude of the nonageſimal degree, $4^{s}$ 26° 32′ 44″, and altitude, 55° 49′ 42″, and Mercury's parallax in longitude from the Sun, 3″. 333; and in latitude, 2″. 322.

At the time of the ſecond external contact, viz. $1^{h}$ 17′ 36″ P.M.

| | |
|---|---|
| ☉'s longitude. | $7^{s}$ 13° 47′ 33″. 5 |
| ☿'s geocentrick longitude. | 7 13 32 10. 73 |
| ☿'s geocentrick latitude. | 5 11. 835 |
| ☉'s right aſcenſion. | 221 19 45 |
| Right aſcenſion of the mid heaven. | 240 43 45 |
| Which ſubſtracted from 270°, gives ∠ at the pole. | 29 16 15 |

From theſe elements we find the longitude of the nonageſimal degree, $7^{s}$ 6° 22′ 32″, and altitude, 34° 15′ 56,″ and Mercury's parallax in longitude from the Sun, 0″. 29; and in latitude, 3″. 416.

At $8^{h}$ 29′ 52″ A. M. the apparent time of ☿'s firſt internal contact, his parallax in longitude from the Sun, was 3″. 323; and in latitude, 2″. 329.

At $1^{h}$ 15′ 44″, P. M. the apparent time of ☿'s ſecond internal contact, his parallax in longitude from the Sun, was 0″. 318; and in latitude, 3″. 412.

For ☿'s ſemidiameter by the obſervation of the contacts, and alſo his latitude, together with the time of the ecliptick conjunction: In fig. 8, Plate 1. let E S K repreſent the ſouthern half of the Sun's diſc; the diameter E ⊙ K a portion of the ecliptick, or rather a line parallel to it, being removed from it = the Sun's parallax in latitude; C ☿ Mercury's viſible geocentrick latitude at the time of the firſt external contact; L M his viſible geocentrick latitude, at the time of the ſecond external contact; the line M U drawn from the point M parallel to K E = Mercury's viſible motion upon the Sun's diſc, between the two external contacts, reduced to the ecliptick; conſequently, ☿ U = his viſible motion in geocentrick latitude, during the time which paſſed between the two external contacts. Therefore, ☿ M is the viſible tranſit line; and ☿ M U, the angle which this line makes with the ecliptick. The point ⊙ is the Sun's centre, at the apparent time of the viſible conjunction of centres; ⊙ N perpendicular to ☿ M, the viſible leaſt diſtance of centres; ⊙ D perpendicular to the ecliptick, the viſible diſtance of centres, at the time of the viſible ecliptick conjunction; ☿ ⊙ and M ⊙ = the ſum of the ſemidiameter of the Sun and Mercury, the diſtance of centres, at the time of the external contacts; ⊙ i and ⊙ r = the Sun's ſemidiameter, the diſtance of centres, at the time of the contacts of Mercury's centre with the Sun's limb; C U = U F, the viſible difference of longitude of the centres, at the time of the firſt external contact, and ⊙ L the viſible difference, at the time of the ſecond.

The longitude of the nonageſimal degree, at the time of each contact, being leſs than the longitude of Mercury, the parallax in longitude is to be added to Mercury's longitude, at the time of each, to give the viſible; and as Mercury's motion in tranſits is retrograde, and the parallax, at the time of the ſecond external contact, was greater than at the time of the firſt, the length of the viſible tranſit line was greater than the true, by the difference of the parallaxes.

The true latitude, at the time of each contact, was increaſed by the parallax in latitude; and as the geocentrick latitude was decreaſing, and the parallax, at the time of the ſecond external contact, was greater than at the time of the firſt, the viſible motion in latitude was leſs than the true, by the difference of the parallaxes. Hence, we may eaſily find M U and ☿ U as follows:

| | |
|---|---|
| ☿'s parallax in lon. from ⊙ at 1ſt ext. cont. | 3″. 333 |
| Do. at 2d. | 0. 29 |
| Difference. | 3. 043 |
| ☿'s motion on the ⊙'s diſc, with reſpect to the ecliptick, in $4^h$ 53′ 32″. | 28′ 31″. 06 |
| | = 1711″. 06 |
| Add the difference of parallaxes in longitude. | 3. 043 |
| The Sun is = M U. | 1714. 103 |
| ☿'s parallax in lat. from ⊙ at 1ſt ext. cont. | 2″. 322 |
| Do. at 2d. | 3. 416 |
| Difference. | 1. 094 |

☿'s true motion in geocentrick lat. in $4^h$ 53′ 32″. 4 12. 12
=252″. 126
Subtract the difference of parallaxes in latitude. 1. 094

Viſible motion in geocentrick latitude = ☿ U. 251. 032

Having found M U and ☿ U, we eaſily find the length of the viſible tranſit line ☿ M, as follows: M U, 1714″. 103 : ☿ U, 251″. 032 :: Radius : Tangent ∠ ☿ M U, 8° 19′ 54″. 5 : Then Sine ∠ ☿ M U, 8° 19′ 54″. 5 : U ☿ 251″. 032 :: Radius : ☿ M, 1732″. 39; the half of which, viz. 866″. 195, = ☿ N, or M N.

Having obtained ☿ N and M N, we may proceed to find ☿'s ſemidiameter by obſervation.

At the time of the firſt contact, ☿'s horary motion on the ⊙'s diſc, reduced to the ecliptick, was 5′ 49″. 059 : therefore, in 1′ 48″, the time from the firſt external to the firſt internal contact, the motion was 10″. 472. At the time of the laſt contact, the horary motion, with reſpect to the ecliptick, was 5′ 50″. 955, which gives 10″. 917 for ☿'s motion upon the ⊙'s diſc, in 1′ 52″, the time between the ſecond internal, and ſecond external contact. The difference of the parallaxes between the firſt external, and firſt internal contact = 0″. 01, being added to 10″. 472, will give the viſible geocentrick motion of ☿ upon the ⊙, with reſpect to the ecliptick, 10″. 482 in 1′ 48″; and the difference of the parallaxes between the ſecond internal, and the ſecond external contact = 0″. 028, being added to 10″. 917, will give 10″. 945, for the viſible geocentrick motion of ☿ upon the ⊙, with reſpect to the ecliptick, in 1′ 52″. ☿'s true motion in geocentrick latitude, in 1′ 48″ was 1″. 546 ; from which ſubſtract 0″. 007, the difference of the parallaxes in latitude in that time, and we ſhall have 1″. 539, for ☿'s viſible motion in geocentrick latitude. In 1′ 52″, ☿'s true geocentrick motion in latitude, was 1″. 603 ; from which ſubſtract the difference of parallexes in latitude, 0″. 004, and we ſhall have 1″. 599, for ☿'s viſible motion in latitude. With theſe viſible motions in longitude and latitude, we obtain 10″. 594 for ☿'s viſible motion in his path upon the Sun's diſc, in 1′ 48″, and 11″. 061, for his motion in 1′ 52″.

The mean of 10″. 594 and 11″. 061, the motion of ☿ in croſſing the Sun's limb, at the ingreſs and egreſs, is 10″. 827 ; the half of which, viz. 5″. 414, being ſubſtracted from 866. 195, half the tranſit line, between the two external contacts, will leave 860. 781 = half the tranſit line, between ☿'s central contact. = Ni, or Nr. Let the obſerved ſemidiameter of the Sun = 972″. 125, be diminiſhed 4″. 5, for irradiation or inflexion, and we ſhall have 967″. 625, for his ſemidiameter, to be uſed in theſe calculations ; this is = ⊙i or ⊙r. Therefore, in the right angled plain triangles, ⊙☿ N and ⊙ M N, we have the hypothenuſe, ⊙i or ⊙r, and ſide, ☿ N or M N, to find ſide ⊙ N ; which is obtained by multiplying together the ſum and difference of the hypothenuſe and leg, and extracting the ſquare root of the product, which is eaſily done by logarithms. Thus ⊙ N is found = 442″. 071.

Having found ⊙ N, let us aſſume 5″ for the ſemidiameter of ☿, which added to the Sun's ſemidiameter, diminiſhed by inflexion, will give 972″. 665, for ⊙ ☿ and ☿ M ; and ſubſtracted, will give 962″.665, for ⊙s and ☿x ; from which we may eaſily find N ☿ and Ns, and N M and Nx; and conſequently, obtain the ſpaces which Mercury would have run through between the external and internal contacts, had his ſemidiameter been equal to that aſſumed. Theſe ſpaces are ☿s and Mx, each = 11″. 242; but the ſpaces run through by obſervation, were not ſo great; therefore, ☿'s ſemidiameter by obſervation, was leſs than that which we have aſſumed, and may now be exactly obtained. ☿'s by obſervation, was 10″. 594, therefore, 11″. 242 : 5″ :: 10″. 594 : 4″. 712. Mx by obſervation, was 11″. 061; therefore, 11″. 242 : 5″ :: 11″. 061 : 4″. 919. From theſe reſults it appears, that ☿'s ſemidiameter by the obſervation of the two firſt contacts, was 4″. 712; and by the obſervation of the two laſt, 4″. 919; the mean of which is 4″. 815; which we may uſe as the ſemidiameter of ☿, in the calculations which follow.

For ☿'s geocentrick latitude at the time of the external contacts:

We have already found ☿ ⊙ U = N ⊙ D = 8° 19′ 54″. 5, and ☿ N, the viſible tranſit line = 1732″. 39, the half of which, viz. 866″. 195, is = ☿ N or M N; alſo ☿'s ſemidiameter by obſervation = 4″. 815, which added to ⊙'s reduced ſemidiameter, 967″. 665, will give 972″. 48 = ⊙☿: Therefore, ☿N 972″. 48 : Radius :: ☿ N 866″. 195 : Sine ∠ ☿ ⊙ N 62° 57′ 44″. 2. From this ſubſtract ∠ N ⊙ D, 8° 19′ 54″. 5, and the remainder, viz. 54° 37′ 49″. 7, will be = ∠ ☿ ⊙ D; the complement of which angle, viz. 35° 22′ 10″. 3 will be = ∠ ☿ ⊙ C; becauſe D ⊙ C is a right angle. Having found ∠ ☿ ⊙ C, we may ſay, Radius : ⊙ ☿, 972″. 48 :: Sine ∠ ☿ ⊙ C, 35° 22′ 10″. 3 : C ☿, 562.″ 917 =

$9' \; 22''. \; 917$ = the viſible difference of latitude between the Sun and Mercury, at the time of the firſt external contact; from which ſubſtract Mercury's parallax in latitude from the Sun = $2''. \; 322$, and the remainder, viz. $9' \; 20''. \; 595$, will be Mercury's true latitude by obſervation. The latitude by the tables, being $9' \; 23''. \; 961$, the errour is + $3''. \; 366$.

For the difference of longitude of the centres of the Sun and Mercury at the time of the firſt external contact, and conſequently at the time of the ecliptick conjunction:

Radius : ☉ ☿, $972''. \; 48$ :: Sine ∠ ☉ ☿ C, $35^{\circ} \; 22' \; 10''. \; 3$ : C ☉, $792''. \; 995$, the viſible difference of longitude of the Sun's and Mercury's centre; from which ſubſtract $3''. \; 333$, Mercury's parallax in longitude from the Sun, and the remainder, viz. $789''. \; 662$, will be the true difference of longitude by obſervation.

Mercury's heliocentrick motion in longitude from $8^{h} \; 24' \; 4''$, A. M. to $10^{h} \; 39' \; 31''$, A. M. viz. in $2^{h} \; 15' \; 27''$, was by the tables, $1689''. \; 9$; which will give $788''. \; 29$ for his geocentrick motion on the Sun's diſc, reduced to the ecliptick. Therefore, $788''. \; 29 : 2^{h} \; 15' \; 27'' = 8127'' :: 789''. \; 662 : 8141'' = 2^{h} \; 15' \; 41''$; which added to the time of the firſt external contact, viz. $8^{h} \; 24' \; 4''$, will give $10^{h} \; 39' \; 45''$, A. M. for the apparent time of the true ecliptick conjunction by obſervation; being $14''$ later than by the tables.

At $10^{h} \; 39' \; 45''$, the Sun's longitude was $7^{s} \; 13^{\circ} \; 40' \; 57''. \; 1$; conſequently, it being the ecliptick geocentrick conjunction, Mercury's geocentrick longitude was the ſame, which makes his heliocentrick longitude at that time, to have been $1^{s} \; 13^{\circ}$

$40'\ 57''.1$ ; but by the tables, it was $7^s\ 13^\circ\ 41'\ 0''.0$, Mercury's errour therefore, in longitude, was $+\ 2''.9$.

For Mercury's heliocentrick latitude, at the time of the ecliptick conjunction, by obſervation, and his diſtance from the node :

In $2^h\ 15'\ 27''$, or $8127''$, ☿'s motion in geocentrick latitude by the tables, was $1'\ 56''.011$ : Therefore, $8127''$ : $116.011$ :: $8141''$ : $116''.213 = 1'\ 56''.213$. This was Mercury's motion in latitude, in $2^h\ 15'\ 41''$ ; which being ſubſtracted from $9'\ 20''.595$, his geocentrick latitude, at the time of the firſt external contact, will give $7'\ 24''.382$, for his geocentrick latitude, at the time of the obſerved ecliptick conjunction : Then ☿'s diſtance from the Sun : ☿'s diſtance from the earth :: ☿'s geocentrick latitude, $7'\ 24''.382 = 444''.382$ : ☿'s heliocentrick latitude, $952''.578 = 15'\ 52''.578$.

Let ☊ E. Fig 9. be a portion of the ecliptick ; the point ☊ the place of ☿'s aſcending node ; ☊ ☿, a portion of ☿'s heliocentrick orbit ; the point at ☿, his heliocentrick place in his orbit, at the time of the ecliptick conjunction ; and E, his place reduced to the ecliptick ; E ☿, his heliocentrick latitude ; the angle E ☊ ☿, the inclination of his orbit $= 7^\circ\ 0'\ 0''$. In the right angled ſpherick triangle, right angled at E, there are given the angle E ☊ ☿, and the perpendicular or ſide E ☿, to find the baſe or ſide ☊ E = Mercury's diſtance from the aſcending node :

Radius : Tangent, E ☿, $15'\ 52''.578$ :: Tangent co ∠ E ☊ ☿, $83^\circ\ 0'\ 0''$ : Sine, ☊ E, $2^\circ\ 9'\ 20''$ = ☿'s diſtance from the aſcending node.

At $10^h\ 39'\ 45''$, A. M. the time of the ecliptick conjunction, ☿'s heliocentrick longitude was $1^s\ 13^\circ\ 40'\ 57''.\ 1$ ; from which ſubſtract the equation of the node, $13''.\ 7$, becauſe the heliocentrick latitude is found for the longitude unequated ;

| | | | | |
|---|---|---|---|---|
| The remainder is | $1^s$ | $13^\circ$ | $40'$ | $43''.\ 4$ |
| To which add ☿'s diſtance from ☊ becauſe ☿ was advancing to ☊ | | 2 | 9 | 20 |
| The ſum is the place of the aſcending node | 1 | 15 | 50 | 3. 4 |
| Place of ☊ by M. de la Lande's tables of 1771 | 1 | 15 | 51 | 8 |
| Errour of the tables. | | + | 1 | 4. 4 |

PHYSICAL

Plate 1

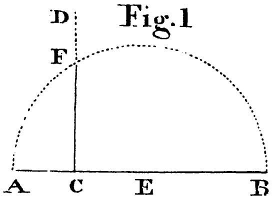
Fig. 1

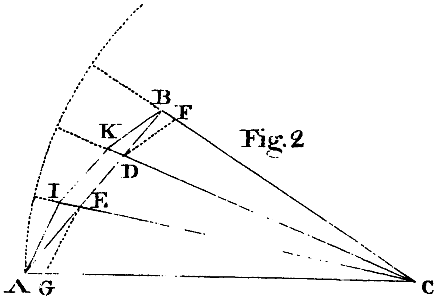
Fig. 2

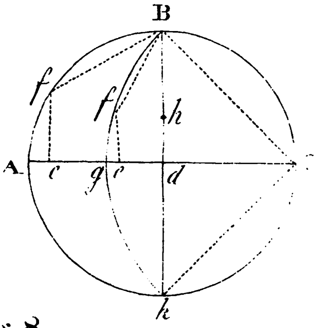
Fig. 5

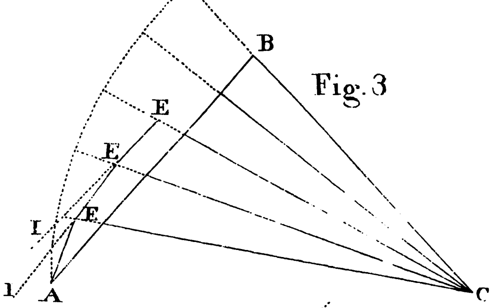
Fig. 3

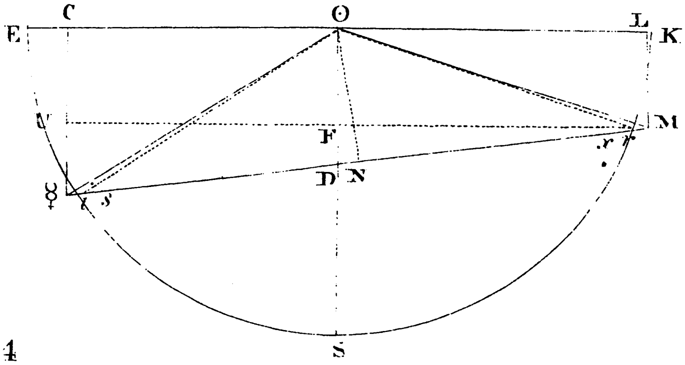
Fig. 8

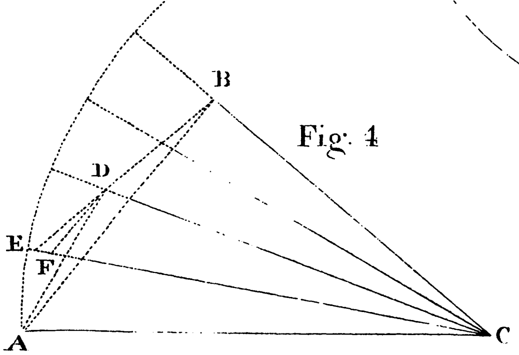
Fig. 4

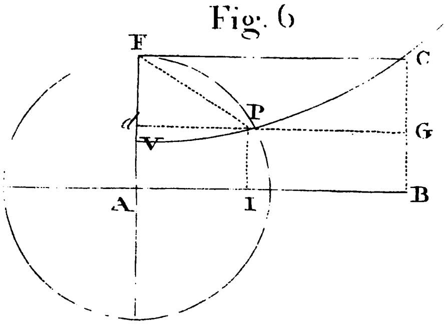
Fig. 6

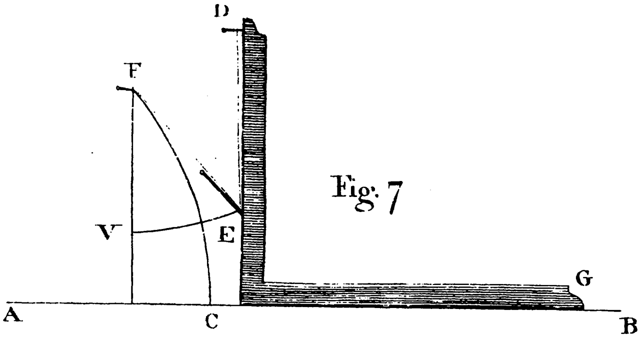
Fig. 7

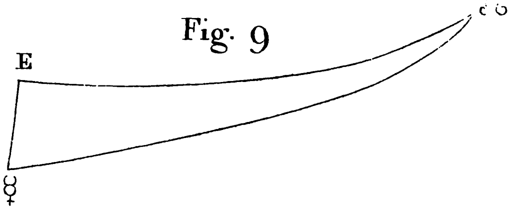
Fig. 9